
SMITHSONIAN INSTITUTION LIBRARIES


SMITHSONIAN INSTITUTION LIBRARIES

QK
1
S664
SI-Ref
c, 2

Flora of Micronesia, 1: Gymnospermae

F. RAYMOND FOSBERG
and
MARIE-HÉLÈNE SACHET

SMITHSONIAN CONTRIBUTIONS TO BOTANY · NUMBER 20

SERIAL PUBLICATIONS OF THE SMITHSONIAN INSTITUTION

The emphasis upon publications as a means of diffusing knowledge was expressed by the first Secretary of the Smithsonian Institution. In his formal plan for the Institution, Joseph Henry articulated a program that included the following statement: "It is proposed to publish a series of reports, giving an account of the new discoveries in science, and of the changes made from year to year in all branches of knowledge." This keynote of basic research has been adhered to over the years in the issuance of thousands of titles in serial publications under the Smithsonian imprint, commencing with *Smithsonian Contributions to Knowledge* in 1848 and continuing with the following active series:

Smithsonian Annals of Flight
Smithsonian Contributions to Anthropology
Smithsonian Contributions to Astrophysics
Smithsonian Contributions to Botany
Smithsonian Contributions to the Earth Sciences
Smithsonian Contributions to Paleobiology
Smithsonian Contributions to Zoology
Smithsonian Studies in History and Technology

In these series, the Institution publishes original articles and monographs dealing with the research and collections of its several museums and offices and of professional colleagues at other institutions of learning. These papers report newly acquired facts, synoptic interpretations of data, or original theory in specialized fields. These publications are distributed by mailing lists to libraries, laboratories, and other interested institutions and specialists throughout the world. Individual copies may be obtained from the Smithsonian Institution Press as long as stocks are available.

S. Dillon Ripley
Secretary
Smithsonian Institution

SMITHSONIAN CONTRIBUTIONS TO BOTANY • NUMBER 20

Flora of Micronesia, 1: Gymnospermae

F. Raymond Fosberg
and Marie-Hélène Sachet

ISSUED
MAR 1 3 1975

SMITHSONIAN INSTITUTION PRESS
City of Washington
1975

ABSTRACT

Fosberg, F. Raymond, and Marie-Hélène Sachet. Flora of Micronesia, 1: Gymnospermae. *Smithsonian Contributions to Botany,* number 20, 15 pages, 1 figure, 1975.—A brief introduction treats the scope and plan of the flora, the circumstances under which it is being written, discussions of special problems encountered, materials used, and acknowledgments. Floristic taxonomic treatments with keys, synonymy, descriptions, distribution, ethnobotany including vernacular names, and citations of geographic records and herbarium specimens are provided for Cycadaceae, Araucariaceae, Podocarpaceae, Pinaceae, Taxodiaceae, Cupressaceae, and Gnetaceae. Other families will follow in future papers as they are completed.

OFFICIAL PUBLICATION DATE is handstamped in a limited number of initial copies and is recorded in the Institution's annual report, *Smithsonian Year.* SI PRESS NUMBER 5162. SERIES COVER DESIGN: Leaf clearing from the katsura tree *Cercidiphyllum japonicum* Siebold and Zuccarini.

Library of Congress Cataloging in Publication Data
Fosberg, Francis Raymond, 1908–
Flora of Micronesia.
(Smithsonian contributions to botany, no. 20)
Bibliography: [v.] 1, p.
Contents: 1 Gymnospermae.
Supt. of Docs. no.: SI 1.29:20
1. Botany—Micronesia. 2. Ethnobotany—Micronesia. I. Sachet, Marie-Hélène, joint author. II. Title. III. Series: Smithsonian Institution. Smithsonian contributions to botany, no. 20.
QK1.S2747 no. 20, etc. [QK473.M5] 581'.08s [581.9'96'5] 74–11316

For sale by the Superintendent of Documents, U.S. Government Printing Office
Washington, D.C. 20402 - Price 70 cents (paper cover)

Contents

Flora of Micronesia, 1: Gymnospermae

F. Raymond Fosberg
and Marie-Hélène Sachet

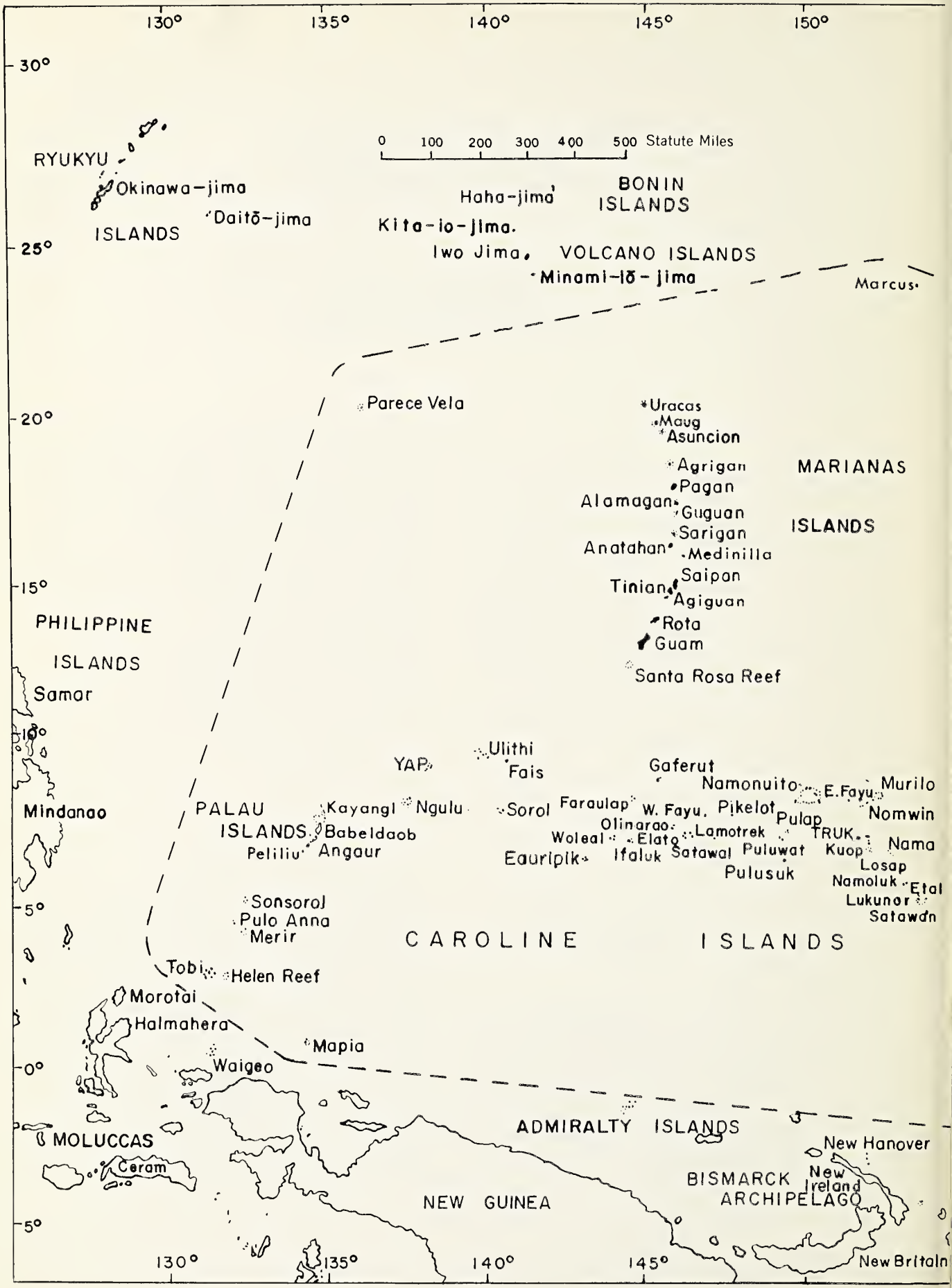
Introduction

The "Flora of Micronesia" will be a systematic, floristic, and ethnobotanical account of the vascular plants of the oceanic area of the Pacific basin termed by Dumont d'Urville (1832) "Micronesia." The islands comprising this region are, roughly, those groups lying north of the equator, west of the International Date Line, south of the Tropic of Cancer, and east of the Philippines. In addition, the Gilbert group extends partly south of the Equator and the isolated raised atolls, Nauru and Banaba (Ocean), also lie south of the equator. The archipelagoes in Micronesia are the Marianas, Carolines, Marshalls, and Gilberts. Included also are the more isolated islands, Marcus, Wake, Nauru, Banaba, and Mapia (Figure 1). This circumscription differs from that of Gressitt (1954) in that it excludes the Bonin and Volcano archipelagoes. The Gressitt volume cited is the best geographic treatment available for Micronesia as a whole and was written to provide a biogeographical background for the series *Insects of Micronesia* edited by Dr. Gressitt, and published by the Bernice P. Bishop Museum.

The aim of the present flora is to provide descriptions, keys, synonymy, bibliographic references, brief statements of distributions and ecology, such ethnobotanical information as is readily available, and citations of all herbarium specimens and geographic references known to us, for all the vascular plant taxa present, native and introduced, in Micronesia. Segments of the Flora, families or groups of related families, will be published as they are ready, rather than in any particular order. Ancillary chapters, such as history of Micronesian botany, vegetational geography, floristics, family key, and perhaps other topics, may be provided also as they are written.

Work toward this Flora started in 1946 in a very informal manner, but including field studies on both flora and vegetation, herbarium studies, and perusal of published work. This was, initially, done in connection with the Micronesian Economic Survey conducted by the U.S. Commercial Company. It was continued, successively, under the auspices of the U. S. Army Quartermaster General's Office, the U. S. Geological Survey, and the Smithsonian Institution, though mostly as a secondary or incidental activity rather than as a primary task. Substantial financial and logistic support has been provided by the Office of Naval Research through the Pacific Science Board of the National Academy/National Research Council, by the National Institutes of Health (National Institute for Neurological Diseases and Blindness), the Smithsonian Research Awards Program, the U. S. Navy, the Army Map Service Far East, the Government of Guam, and the Administration of the Trust Territory of the Pacific Islands. Facilities and access to collections and library resources have been provided by the Library of Congress, the U. S. Department of Agriculture Library, the Bernice P. Bis-

F. Raymond Fosberg and Marie-Hélène Sachet, Department of Botany, National Museum of Natural History, Smithsonian Institution, Washington, D.C. 20560.


130°
135°
140°
145°
150°
30°
25°
20°
15°
10°
5°
0°
5°
0 100 200 300 400 500 Statute Miles
RYUKYU ISLANDS
Okinawa-jima
Daitō-jima
Haha-jima
BONIN ISLANDS
Kita-io-jima
Iwo Jima
VOLCANO ISLANDS
Minami-iō-jima
Marcus
Parece Vela
Uracas
Maug
Asuncion
Agrigan
Pagan
Alamagan
Guguan
Sarigan
Anatahan
Medinilla
Saipon
Tinian
Agiguan
Rota
Guam
Santa Rosa Reef
MARIANAS ISLANDS
PHILIPPINE ISLANDS
Samar
Mindanao
PALAU ISLANDS
Kayangl
Ngulu
Babeldaob
Peliliu
Angaur
YAP
Ulithi
Fais
Sorol
Faraulap
Olinarao
Woleai
Elato
Eauripik
Ifaluk
Gaferut
W. Fayu
Pikelot
Namonuito
Lamotrek
Satawal
Puluwat
Pulusuk
Pulap
E. Fayu
Murilo
Nomwin
TRUK
Kuop
Nama
Losap
Namoluk
Etal
Lukunor
Satawan
Sonsorol
Pulo Anna
Merir
CAROLINE ISLANDS
Tobi
Helen Reef
Morotai
Halmahera
Mapia
Waigeo
MOLUCCAS
Ceram
ADMIRALTY ISLANDS
New Hanover
BISMARCK ARCHIPELAGO
New Ireland
NEW GUINEA
New Britain

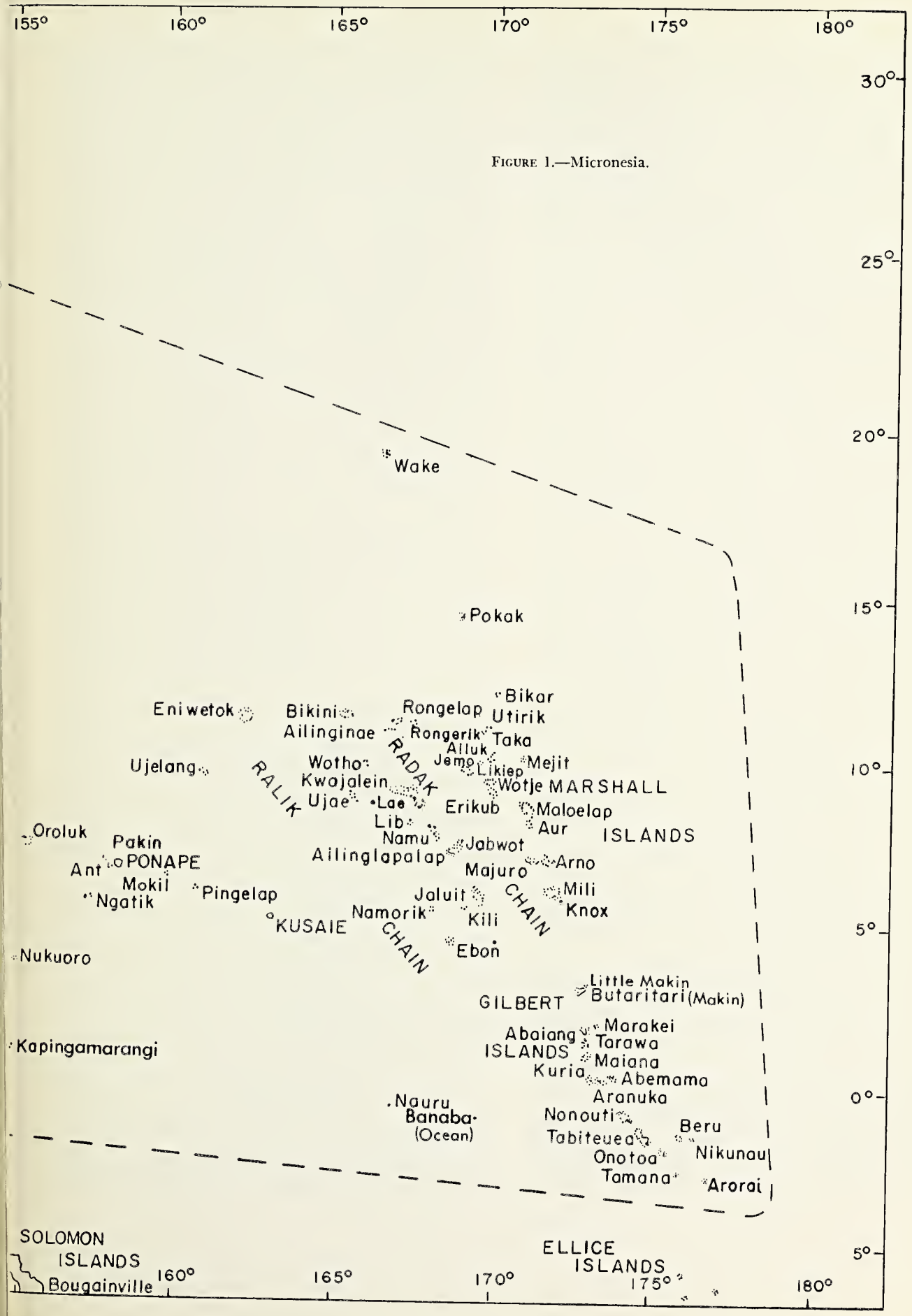


FIGURE 1.—Micronesia.

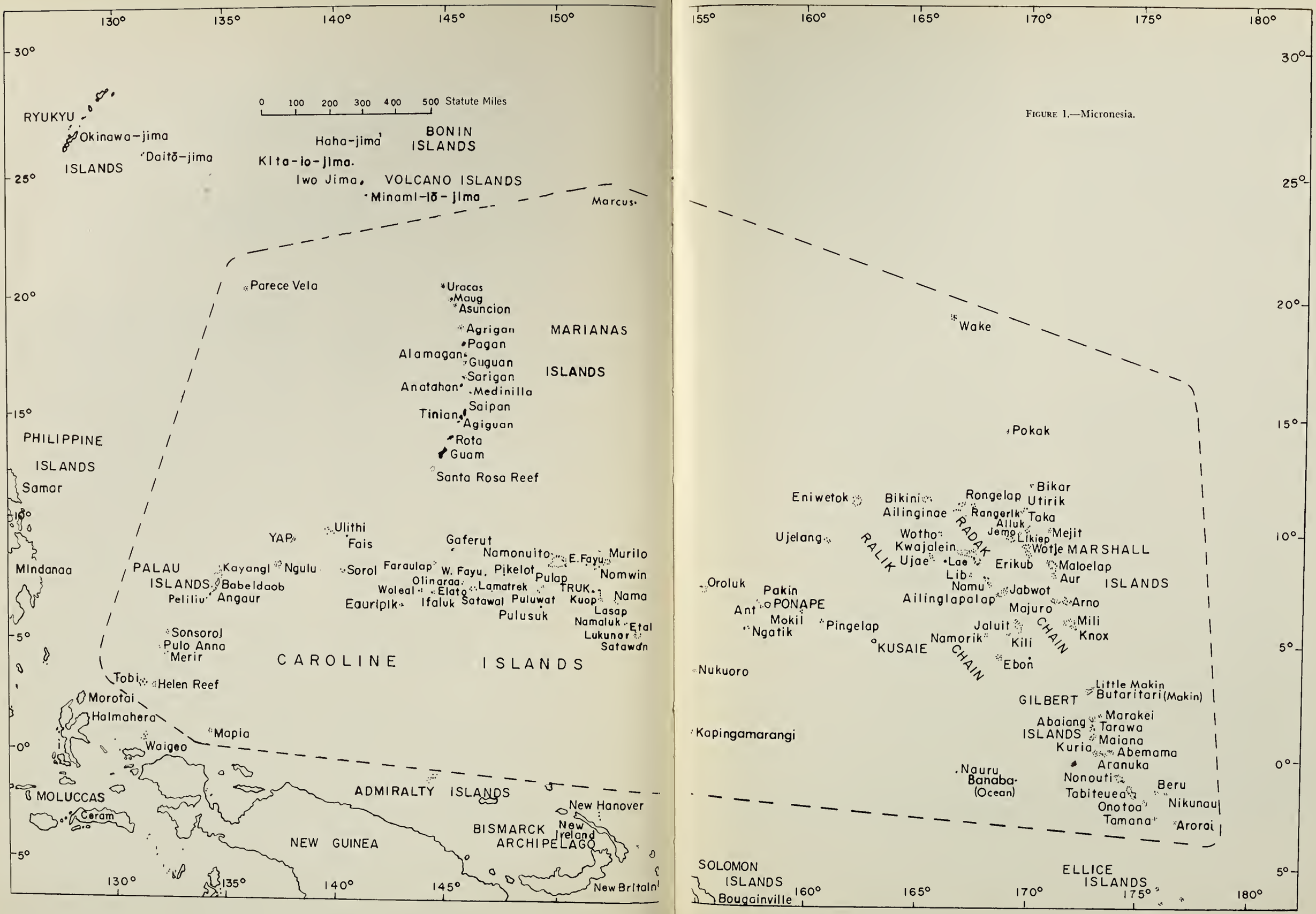


FIGURE 1.—Micronesia.

hop Museum, the University of Guam, and many of the great herbaria of the world, especially the U. S. National Herbarium, the New York Botanical Garden, the Arnold Arboretum, Kew, the British Museum (Natural History), the Muséum National d'Histoire Naturelle (Paris), the Conservatoire Botanique (Geneva), the National Herbarium of New South Wales (Sydney), the Istituto Botanico (Florence), and the herbaria of the universities of Tokyo, Kyushu, and Kyoto, Japan. To the authorities of these institutions and agencies we wish to express our gratitiude and to acknowledge our indebtedness. The various individuals who have helped in many ways, both personal and official, are too many to enumerate, but we do express our appreciation and our hope that at least some of them may find the parts of the Flora, as they appear, useful or interesting. Special credit must go to our many field and herbarium assistants, guides, and informants, and particularly to the typists and clerks who have faithfully typed field notes, labels, and manuscripts.

A bibliography of the botany of Micronesia and a supplement to it have been compiled and published (Sachet and Fosberg, 1955, 1971) as a back-up for this work. All the articles that we have found dealing in any way with Micronesian plants, up to 1971, are there listed and annotated.

The herbaria in which the studied materials are deposited are indicated by standard *Index Herbariorum* (Lanjouw and Stafleu 1964) abbreviations in parentheses after each specimen citation. Additionally, UG is for University of Guam, and Fo indicates material still in the authors' hands, not yet distributed. Collectors' names and numbers are indicated in italics if we have seen the specimens. Most of our own collections are deposited in the U. S. National Herbarium, but large numbers of duplicates have been or will be placed in appropriate other herbaria.

In addition to our own collections and those cited from various herbaria, we have identified large numbers of specimens for various collectors—botanists, anthropologists, Peace Corps volunteers, and others—who have submitted them for our help. These are or will be deposited in the U. S. National Herbarium, except where too fragmentary to be useful, and are included in the lists of cited specimens. They have contributed enormously to the completeness of the distributional records and to our knowledge of the morphology and ethnobotany of many Micronesian species.

Taxonomic judgments are our own, but we gratefully acknowledge the advice and influence of many colleagues. Many local informants have supplied information on uses and local names of plants.

An attempt has been made to examine types and to see and verify the original place of publication of each botanical name used and each synonym. Much work has been done on the taxonomy and nomenclature of the groups concerned, even outside Micronesia, in order to understand the Micronesian species and their relationships. Many of the widespread tropical species have been reviewed, some of them exhaustively, in order to avoid perpetuating old errors. We have found the great *Flora Malesiana,* produced at Leiden under the able direction of Prof. C. G. G. J. van Steenis, and papers in *Blumea* precursor to it, of enormous assistance.

In the synonymy, we have cited principally those names used in works dealing with Micronesia. In addition we have cited basionyms of accepted names and a few other names needed to understand our choice of correct names. Subsequent references to Micronesian literature are added under the names used by the authors cited. These are arranged chronologically following each name.

Brief mention must be made here of a few basic works in Micronesian botany, though our intention is to discuss the history of Micronesian botany at greater length in a later fascicle of the flora. The most comprehensive works dealing with the plants of the region are by Gaudichaud (1826), Safford (1905), Merrill (1914, 1919), Kanehira (1933, 1935), Taylor (1950), Glassman (1952), and Stone (1971). Professor Takahide Hosokawa has generously made available to us his manuscript, "Enumeration of the Flora of Micronesia," compiled before World War II but never published. We extend our sincere thanks to him. He, as well as Professor Ryozo Kanehira and Professor Takasi Tuyama, published a large number of short papers on Micronesian plants in the years before World War II, which added enormously to our knowledge of the flora. These are cited at appropriate places in our flora.

Unpublished or duplicated lists of the plants of Guam by E. H. Bryan, Jr. (1946) and Fosberg

(1960) and of the plants of Palau by Demei Otobed (1967, 1971) are only cited where they provide the first or only records of species from these islands.

The ethnobotanical information offered varies enormously in amount and reliability from species to species. Since we ourselves have not made intensive and critical ethnobotanical studies, we have chosen to present all appropriate information obtained from casual informants in the field and from herbarium labels, and much of that found in the literature on Micronesian plants, generally without comment as to its reliability. In certain cases where published information is too extensive to quote, or where unpublished information exists that we are not free to quote, we merely give references or other information that may lead the reader to such sources.

Vernacular names present a serious problem, both as to application and as to orthography. Whenever possible we cite a specimen to which the collector or field informant has applied a name. Being quite unable to make authoritative choices among alternative orthographies, we have generally given the spellings recorded, with an indication of the island or archipelago where they were obtained. In many cases linguistic studies beyond the scope of our work may clear up the discrepancies. We have not attempted to use any of the available special phonetic alphabets, but have, when recording names in the field, merely attempted to approximate the nearest English rendering of the sounds. We are quite aware of the shortcomings of this approach, as well as of the poor reliability of many local informants and sources of vernacular names.

There is a vast and intricate synonymy of the place names in the Pacific Islands, which may be discussed in more detail in a later fascicle of the flora. Here it is sufficient to explain that we have chosen a familiar name for each island and locality, and a single spelling of it, and adhered to these as faithfully as we could. They may not necessarily be the most acceptable, but it is hoped they may be generally understood and readily located on maps at adequate scales. Uniformity has not always been possible for local names of small islets and places on islands, as these are frequently quoted as they are written on labels or in earlier works and are seldom found on maps. The problem is a general one and quite beyond our control. Gressitt (1954) includes a gazetteer, cross-indexing many Micronesian names as a chapter of his Introduction.

Key to the Families of Gymnospermae

1. Leaves large, compound ..... CYCADACEAE
1. Leaves small, simple, needle-like, scale-like or blade-like 2
   2. Leaves in small fascicles (in ours), needle-like ..... PINACEAE
   2. Leaves not in fascicles 3
      3. Leaves of at least older portions of plant scale-like, opposite ..... CUPRESSACEAE
      3. Leaves needle-like or blade-like 4
         4. Leaves needle-like (in ours), alternate or spirally arranged 5
            5. Leaves (in ours) in clear conspicuous spirals, cones over 2 cm long, disarticulating when ripe ..... ARAUCARIACEAE
            5. Leaves obscurely or irregularly or not spirally arranged, scales peltate or thickened toward apex ..... TAXODIACEAE
         4. Leaves flat, blade-like 6
            6. Leaves (in ours) alternate, lanceolate, seed on a swollen, fleshy receptacle ..... PODOCARPACEAE
            6. Leaves opposite, ovate to elliptic or oblong; "flowers" or seeds in whorls, subtended by collar-like bracts, arranged in elongate spike-like strobiles ..... GNETACEAE

CYCADACEAE

Plants with thick woody stems, with thick pith, large pinnately compound leathery leaves, reproductive parts dioecious, microsporangia on scale-like microsporophylls, megasporangia on variously formed megasporophylls; seeds naked, outer seed-coat fleshy, inner bony, endosperm copious, starchy; sperms ciliated, motile.

A small family with nine genera scattered

through the tropics and subtropics, only one genus in Micronesia. An ancient group, considered the most primitive of seed plants.

Cycas L.

Cycas L., Sp. Pl. 1188, 1753.—Schuster, Pflanzenreich IV, 1 (99): 64–84, 1932.—Fosberg, Federation Proc. 23:1340–1342, 1964.

Palm-like shrubs or small trees with thick trunks, columnar or sparsely branched, with crowns of large pinnate leathery leaves; microsporophylls scale-like, in large cones or strobiles that elongate when ripe; megasporophylls leaf-like with expanded sterile terminal appendages, borne in whorls between whorls of leaves; seeds borne along the edges of the flattened megasporophylls, large, drupelike, several centimeters across, scarcely compressed.

An Old World genus, extending from the east coast of Africa east to the Samoan, Caroline, and Marianas islands and north to southern Japan, planted as an ornamental throughout the tropics and subtropics, and in greenhouses in cooler climates. One native and one planted exotic species in Micronesia. All parts of the plant are poisonous.

Key to the Micronesian Species of *Cycas*

Leaf segments flat, not ending in a rigid, pungent point ..... ***C. circinalis***
Leaf segments somewhat revolute, ending in a rigid, pungent point ..... ***C. revoluta***

Cycas circinalis L.

Cycas circinalis L., Sp. Pl. 1188, 1753.—Gaudichaud, Bot. Voy. Uranie, 432–441, 1826 [1829].—Endlicher, Ann. Wien Mus. Naturgesch. 1:164, 1835.—F. de la Corte, Memoria descr. hist. Islas Marianas, 57, 1875.—Schumann and Lauterbach, Fl. D. Schütz. Süds., 154, 1901.—Safford, Contr. U.S. Nat. Herb. 9:252–253, 1905.—Merrill, Phil. Jour. Sci. C. Bot. 9:47, 1914.—F. de la Corte, [transl.], Guam Recorder 3:171, 1926 [reprinted II, 2 (4):18, 1972].—Schuster, Pflanzenr. IV, I (99):66–76, 1932.—Merrill, Proc. 5th Pac. Sci. Cong., 4:3269, 1934.—Bryan, Guam Recorder 13 (12):13, 1937 [Guam Dailey News (reprint), 20 Mar. 1957].—St. John, Pac. Sci. 5:280, 1951.—Glassman, Bish. Mus. Bull. 209:52, 1952; Pac. Sci. 7:293, 1953.—Massal and Barrau, So. Pac. Comm. Techn. Pap. 94:27, 1956.—Catala, Atoll Res. Bull. 59:91, 1957.—Whiting, Econ. Bot. 17:270–302, 1963.—Fosberg, Résumé Cycadac., Federation Proc. 23 (6):1340–1342, 1964.—Barrau, Ethnology 4 (3):282–294, 1965.—Moore, Guam Sci. Tchrs. Assn. Newsletter 2 (4):6, 10, 1967.—Inman, Micronesica 3:59–60, 1967.

Cycas undulata Desfontaine, Hort. Par. 1820.—Gaudichaud, Bot. Voy. Uranie, 434, 1826 [1829].

Cycas rumphii Miquel, Bull. Sci. Phys. Nat. Néerl. 45, 1839.—Volkens, Bot. Jahrb. 31:455, 1901.—Kanehira, Jour. Jap. Bot. 14:157–158, 1938.

Cycas seemannii A. Braun, Sitzb. Ges. Naturf. Fr. Berlin 114, 1876.—Von Prowazek, Deutschen Marianen, 113, 1913.

Cycas circinalis f. *undulata* (Desfontaine) Schuster, Pflanzer. IV, 1 (99):66, 1932.—Stone, Micronesica 6:65–66, 1971.

Cycas circinalis ssp. *seemannii* (A. Braun) Schuster, Pflanzer. IV, 1 (99):71, 1932.—Kanehira, Fl. Micr. 59, 1933; Enum. Micr. Pl., 258–259, 1935.

Cycas rumphii f. *palauica* Kanehira, Jour. Jap. Bot. 14:587, 1938.—Tuyama, Kagaku Nanyô 3:11, 1941.

Cycas rumphii f. *undulata* (Desfontaine) Kanehira, Jour. Jap. Bot. 14:587, 1938.

Small tree to 5 m or more, rarely branched, leaves to 1–1.5 m long with numerous linear pinnae in one plane, 10–17 mm wide, flat, leathery, strongly acuminate but not pungent; staminate cone ovoid, elongating to narrowly fusiform, as much as 70 cm; megasporophylls densely tawny-tomentose, to 20 cm long; seeds 3–5 cm long, subglobose to broadly ellipsoid-oblong, flesh thin, rather hard, inner layer compressed apically.

According to Schuster's monograph, the Micronesian material goes into f. *undulata* and ssp. *seemannii* of this species. The material at hand is not adequate to determine if these segregates are of any significance, since good material from India is not available. The species is undeniably variable, but the monograph is so poorly written that sound judgment cannot be based on it. For the present the best disposition seems to be *C. circinalis* L. sensu lato. The Palau plants, so far as observed, have notably smaller seeds than those in the Marianas (cf. *Fosberg 47664*). This may, after study of more material, justify Kanehira's recognition of this entity as a forma.

Found in a multitude of forms from Zanzibar and the adjacent African coast eastward to Fiji and Samoa, and north to the Marianas; in Micronesia native in the southern Marianas: Saipan, Agiguan, Rota, Guam; Carolines: Palau and Yap, planted as an ornamental eastward to Ponape, Kusaie, and the Marshalls and Gilberts, as well as throughout the tropics. Very common in forests on limestone

in the Marianas and Palau, also on cliffs, but not confined to limestone, as it is found in ravine forest patches on volcanic soil in southern Guam and in valleys in Yap; tends to lose leaves in extreme dry periods.

Ethnobotanical Information

Uses:—Gaudichaud, writing of Guam, says:

The fruits of *Cycas* are prepared in the same way as the pith [the latter previously described for the Moluccas] but are much better. They are cut in pieces, macerated in water for 36, 48 or 72 hours; the length of time varies according to the temperature, the size of the pieces, the quantity involved, etc. Generally, it is best to continue maceration beyond the necessary time, rather than stop it too soon, as many examples show that very serious accidents, even death, may follow the use of poorly prepared meal. The general precautions to be observed are:

1. cut the ripe fruits as small as possible, it would be better even to chop, scrape or pound them; 2. not to work on too large an amount at once; 3. to stir and even to knead the fruit, to hasten the solution of the poisonous substance to be extracted; 4. to renew the water at least every 18 or 24 hours. This length of time is enough, in these warm regions, to get the solution to the beginning of fermentation which I believe to be favorable to the process; 5. finally, to squeeze the mass with a very strong press before drying.

It has long been known that *Cycas* can be multiplied by cuttings. This was demonstrated to me by Don Luis de Torres. He called my attention to the fences of gardens made by *Cycas* trees 5–6 feet tall and so close together that it was difficult, even often impossible, to pass the hand between them; he told me that these trees, brought from the mountains when already large, had been cut near the base, thrust 5–6 inches into the ground and had grown new roots and continued developing. With surprise I learned that not only the trunk or part of the trunk of this tree, with leaves, but also slices, pieces or even chips from this trunk would form new individuals, it was not even necessary, according to Don Luis, to bury these cuttings; a thousand times he saw them simply scattered on the surface of the ground and produce the same phenomenon . . . . I think Don Luis meant to tell me that the female plants rooted better than the male, or perhaps that only the female plants grew successfully, I suspect the latter is what he wanted to say.

Another way of reproducing *Cycas* by cuttings is to take young plants a year or 18 months of age, which then look rather like long, thick, fusiform roots, marked at irregular intervals with concave spots like scars or "eyes", to cut them in pieces, as is done for potatoes, and to plant or simply scatter them on the surface of the ground.

The trunk of *Cycas* is ordinarily single, but some may be double. This occurs under various circumstances, especially when trunks are cut a few inches above the ground, two or more buds soon develop at this base; normally only one survives, but sometimes two, which may become grafted one on the other with the appearance of only one crown of leaves. Buds may form anywhere along the stem, but especially in the top three-fourths of the trunk.

It has long been known that *Cycas* produces a gum. I have seen it abundantly on the trunk and sometimes the spadices of this plant, in the Marianas. In March, April and May I found all the female *Cycas* loaded with almost ripe fruit, the upper part of the trunk being covered with gum. I collected 4 to 6 pounds of it from 2 or 3 plants, but some trees must have carried 5 or 6 pounds. This gum is similar to gum arabic or gum tragacanth. It occurs in white or yellow-white pieces, vermiculate, twisted, tough. In the mouth it has a taste slightly sweet at first, then very bland and turns almost completely to a sort of jelly. When hungry, I often ate some, but always with renewed distaste. In boiling water, some of it dissolved, the rest turns to mucilage [Guam: Guadichaud 1826:435–441, abstract of a translation by M.-H. Sachet]

The Mariana people cook the yellow fruit in water, pound them and use the resulting thin paste for starch in laundering [Volkens, 1901:455, translation by M.-H. Sachet].

In Guam the seeds of *Cycas circinalis*, called "fadang" or "fadan" in the vernacular of the island, and "bitiogo" or "federico" by the Filipinos and Spaniards, were an important food staple of the aboriginal inhabitants. As in other members of the family the trunk contains sago, but in Guam this has never been utilized. As prepared now by the natives, the endocarp [sic] of the seed is either grated or broken into small pieces and soaked for several days in water, which must be changed from time to time. When fresh the seeds are so poisonous that the water in which they are steeped is fatal to chickens if drunk by them. The poisonous principle contained in the seeds has not yet been ascertained. After having been thoroughly soaked the fadang is dried in the sun and put aside for use. In preparing it for food the natives grind it on a stone slab (metate) with a cylindrical stone rolling-pin (mano), mix it with water, make it into a thin cake, and bake it on a slab or griddle, like a tortilla of maize. If eaten continously for any length of time it is injurious. The natives now resort to it only when maize is scarce, or in times of famine following hurricanes, when almost all other fruits are destroyed. In the old letter books at Agaña I find copies of reports of several Spanish governors to the captain-general of the Philippines, in which they complain of the unwholesomeness of this food and the injurious effects it has upon the natives. As far as my personal experience goes it is palatable and not injurious if eaten occasionally and in small quantities, although it is inferior to maize in every respect. Starch is sometimes made of the seed, but this is not very white and has a disagreeable odor. It is good for paste, however, and is avoided by insects. These seeds are used as food in the southern islands of the Philippine group, and the bracts and fruit are an excellent vulnerary [Guam: Safford, 1905:253]. Prolonged use of fadang flour makes people very excitable [Guam: Don Felipe de la Corte, 1875 (transl., 1926)]. Content of nut washed and dried to form the edible flour [Guam: Bryan 1937]. Seeds used for food, toxic in raw state [Guam: Massal and Barrau 1956].

Green husks are chewed to relieve thirst in the jungle; when dried they are eaten as a sweet.

The shells are beaten off the hard seeds with sticks or bottles. Persons participating in this work often become dizzy and are forced to go some distance to lie down and recover. Children are not allowed to assist with this part of the processing.

Fifty-gallon drums are commonly used for soaking the cut embryos. Fermentation is accompanied by the formation of a thick white foam on top of the soaking mass. The recommended period for soaking varies with different families from a "few" days to a "few" weeks with several changes of water. Because the "soaking" water is reputed to cause death to dogs and chickens who drink it, the wise farmer protects his animals by digging a hole in the ground for wash water from the cycad seeds.

Halves or slices of the soaked kernel are dried in the sun, often spread on corrugated tin roofing. When hard and brittle, the pieces are stored in a tin can until needed. They can be stored indefinitely.

The kernel, after processing (soaking and sun drying), is ground on a stone "metate" to a fine white starch for use in cooked dishes as tortillas, soups, desserts, and doughnuts. The adhesive quality of the starch makes it especially desiralbe for tortillas. Many persons, particularly older Chamorro, prefer it to corn or wheat flour. Large quantities were consumed during World War II because of shortage of imported foods. At the present time cycad starch is marketed in Guam at about 10 cents per pound.

Individuals often report headache and nausea following consumption of foods prepared with cycad flour. However, in spite of occasional complaints, Guamanians continue to use the plant either for economic reasons or for preference for the flavor or texture.

Juice from the fresh kernel is applied to open wounds, leg ulcers, abscesses, and boils. The exudate hardens and the wounds heal after a few applications. This remedy was in common use during World War II [Whiting, 1965, ms.].

Poisonous properties discussed (Inman, 1967: 59–60).

Formerly used for food (Palau, *Fosberg 32376*).

Vernacular Names.—

fadan (Marianas: von Prowazek, 1913)
fadang (Marianas: von Prowazek, 1913)
fadane (Guam, Chamorro name: Gaudichaud, 1826)
fadang (Guam: *Whiting 320, C 25,* Merrill, 1914)
federico (Guam (*Whiting 320, C 25*)
federico (Guam, Spanish name: Gaudichaud, 1826)
gab-gab (starch, Guam: Gaudichaud, 1826)
gaou-gaou (starch, Guam: Gaudichaud, 1826)
kokeal (Palau: *Raymundus 248*)
klemia (Palau: *Fosberg 32376*)
remiang (Palau: S. Walleser and A. Krämer in Tuyama, 1941)
rumiyan (Palau: Kanehira, 1933)
faretoul (Sonsorol: *Berry 79*)
fallutier (Yap: Volkens, 1901)
fratel (Yap: Kanehira, 1935)
frotel (Yap: Kanehira, 1935)
manuatababa (Nukuoro) *Carroll 80*)
langok (Majuro: St. John, 1951)
lokok (Arno: *Anderson 3719*)

Geographic Records and Specimens Examined

Marianas Islands.—Endlicher, 1835:164. Schumann and Lauterbach, 1901:154. Von Prowazek, 1913:113. Merrill, 1934:3269.

Saipan: Kanehira, 1933:59. Kagman, *Courage 72* (US, Fo).

Agiguan: *Kondo* in 1952 (BISH).

Rota: *Necker R–87* (US). *Kondo* in 1952 (BISH). Kanehira, 1938:587. Savana, *Hosokawa 7603* (A). North coast, east of Tatacho, 3 m, *Fosberg 31830* (US, BISH, Fo, NY). Track from Mackay Beach, 5–10 m, *Evans 2148* (US, BISH), *2149* (US, BISH).

Guam: *Whiting 320* (US). *Necker 15* (US). *G.E.S. 406* (US). *Hombron* in 1841 (P, Fo) Gaudichaud, 1826 [1829]:435–441. Safford, 1905:252. Merrill, 1914:47. F. de la Corte, 1926: 171. Massal and Barrau, 1956:27. Bryan, 1957. Inman, 1967:59. Tumon Bay, *Rodin 507* (US). Ypao Pt., *Necker 95* (US). First terrace below top of plateau, north of Northwest Field, 400 ft [120 m] *Steere 16* (US), *17* (US), *19* (US), *21* (US). Merizo, lower slope, Mt. Schroeder, 150 m, *Bryan 1240* (US, BISH, FU). Mt. Lamlam, 360 m, *Fosberg 46256* (US). Santa Rosa, *Moran 4375* (UC, Fo). Manilao, *Whiting C25* (Fo). Slope of Mt. Almagosa, 200 m, *Stone 4110* (BISH). Ritidian Pt., 160 m, *Fosberg & Evans 46228* (US), 170 m, *Fosberg 25300* (US, BISH, Fo, NY). Talofofo River Valley, 1–2 miles [1.6–3.2 km] above mouth, 10 m, *Fosberg 32644* (US, BISH, Fo, NY). High ridge north of Talofofo Bay, 110 m, *Fosberg* and *Evans 46237* (US, BISH, Fo, NY, L). West side Barrigada Hill, *Stone 4670* (UG).

Caroline Islands.—Schumann and Lauterbach, 1901:154. Endlicher, 1835:164.

Palau: Schuster, 1932:71 (citing Raymundus 248). Tuyama 1941:11. Kayangl: Ngajangel I., *Gressitt 21* (US). Babeldaob: East coast of island, Ngatkip, Airai, 0–5 m, *Fosberg 32376* (US, BISH,

Fo, NY, L). Orukuizu: "Seventy Islands" Nature Reserve, *Fosberg 47664* (US). Peliliu: "Purple Beach" (east coast coral spit), 2 m, *Fosberg 32009* (US, BISH). Coral island: *Kanehira 233* (FU) (seed with fleshy part, 6 × 5 cm), *Kanehira 2408* (FU) (sterile).

Sonsorol: North end of island, *Berry 79* (US).

Yap: Volkens, 1901:455 (citing Volkens 195). Moloai, *Hosokawa 8998* (BISH, Fo). Takiol, *Takamatsu 1849* (BISH). *Kanehira 1189* (FU) (sterile).

Nukuoro: Nukuoro I., planted, 1–2 m, *Fosberg 26192* (US, BISH). *Carroll 80* (US).

Ponape: Glassman, 1952:52, planted.

Mokil: Observed as an ornamental. Introduced from Ponape, Glassman, 1953:293.

Kusaie: Hosokawa, n.d.

Marshall Islands.—

Kwajalein: Seen growing in pot by Fosberg in 1958.

Likiep: Likiep I., *Fosberg 36632* (US, BISH), planted, said to have been brought from Arno.

Majuro: Majuro I., observed in cultivation, St. John, 1951:280.

Arno: Ine I., *Anderson 3719* (US, BISH, Fo).

Jaluit: *Lyman 4* (US, BISH).

Gilbert Islands.—Tarawa: Very rare in the Gilberts, some fine specimens not over 2.50 m tall were seen at Butaritari and in the garden of the Residency at Bairiki (Tarawa); Catala, 1957:91.

Cycas revoluta Thunberg

Cycas revoluta Thunberg, Fl. Jap. 229, 1784.—Okabe, Jour. Jap. For. Soc. 23:267, 1941.—Stone, Micronesica 6:66, 1971.

A small shrub, tending to be columnar at first, then branched; leaves folded or becoming so; pinnae also folded, very narrow, and pungent at tips, megasporophylls until maturity incurved forming a cephalium, later spreading.

Native to the Ryukyu Islands and southern Japan, planted as an ornamental in all tropical and subtropical countries, uncommonly grown in Micronesia, known from Guam, Palau, and Jaluit.

Geographic Records and Specimens Examined

Marianas Islands.—Guam: Stone, 1971:66.

Caroline Islands.—Palau Islands: Koror: Ngerabe'ed, 10 m, *Fosberg 32052* (US, BISH).

Marshall Islands.—Jaluit: Okabe, 1941:267.

Synonyms and Excluded or Misapplied Names

Cycas circinalis ssp. *seemannii* (A. Braun) Schuster. See *C. circinalis* L.

Cycas circinalis f. *undulata* (Desfontaine) Schuster. See *C. circinalis* L.

Cycas rumphii Miquel. See *C. circinalis* L. (at least for Micronesian material).

Cycas rumphii f. *palauica* Kanehira. See *C. circinalis* L.

Cycas rumphii f. *undulata* (Desfontaine) Kanehira. See *C. circinalis* L.

Cycas seemannii A. Braun. See *C. circinalis* L.

Cycas undulata Desfontaine. See *C. circinalis* L.

ARAUCARIACEAE

Trees; leaves alternate, subulate or flattened, spirally arranged or distichous; staminate cones with many scales, microsporangia linear; ovulate cones with scales 1-ovuled, deciduous at maturity, seeds with or without wings.

Two genera, widely distributed in the southern hemisphere and reaching equatorial regions.

Araucaria Jussieu

Araucaria Jussieu, Gen. Pl. 413, 1789.

Dombeya Lamarck, Encycl. Meth. 2:301, 1786; t.828, 1793 [non L'Héritier, nec Cavanilles].

Eutassa Salisbury, Trans. Linn. Soc. 8:316, 1807.

Trees with whorled branches; strobiles usually dioecious, the staminate fascicles terminal, the ovulate terminal, large and woody at maturity, disarticulating; scales wedge-shaped; seeds wingless but adnate to scales, giving a winged appearance because of thin scale margins.

A few species, scattered around the southern hemisphere in temperate South America, Australia, New Guinea and the Pacific Islands; one species sparingly planted in Micronesia.

Araucaria heterophylla (Salisbury) Franco

Araucaria heterophylla (Salisbury) Franco, Anais Inst. Super. Agron. Lisboa, 19:11, 1952–1953 [sic].

Dombeya excelsa Lambert, Descr. Gen. Pinus, ed. 1, 87, 1803 [1806] [nom. illegit., superfluous, as an available name, *Cupressus columnaris* Forster f., Prodr. 67, 1786, cited in synonymy].

Eutassa heterophylla Salisbury, Trans. Linn. Soc. London 8: 316–317, 1807.

Araucaria excelsa Aiton f., Hort. Kew., ed. 2, 5: 412, 1813 [this is the first legitimate publication of *A. excelsa*, which dates from here and is not regarded as a transfer].

Very symmetrical tree with whorled horizontal branches; twigs distichous, at least when tree is young; leaves subulate, rather incurved, conspicuously spiralled.

Native to Norfolk Island, widely planted as an ornamental, sparingly planted in Micronesia, known from Guam, Palau, Truk, and Namoluk; seen in a pot in Kwajalein in 1956.

Geographic Records and Specimens Examined

Marianas Islands.—Guam: Cultivated, *Stone 4679* (UG).

Caroline Islands.—Palau: Koror: Ngarmid, around old temple grounds, 100 m, *Fosberg 32329* (US).

Truk: Moen, Agricultural Substation, 150–200 m, *Evans 1431* (US, BISH, Fo, NY).

Namoluk: Namoluk I., *Mac Marshall 61* (US).

PODOCARPACEAE

Resinous trees and shrubs; leaves spirally arranged or distichous, evergreen, linear, lanceolate or rarely ovate, or scale-like; strobiles monoecious or dioecious, anthers 2-celled; ovules solitary or clustered in very reduced strobiles, one on each fertile scale; seed borne on a fleshy receptacle or enclosed by fleshy scales.

Seven genera; only *Podocarpus* prominently tropical, rarely cultivated in Micronesia. The family is united by some with the Taxaceae.

Podocarpus L'Héritier

Podocarpus L'Héritier ex Persoon, Syn. Pl. 2:580, 1807 [nom. cons.].

Trees with green branchlets, leaves alternate or rarely opposite, linear to lanceolate, rarely ovate or scale-like; seeds drupe-like, borne on a fleshy receptacle.

Found in tropical mountain regions and in the southern hemisphere, northward to Japan, one species planted as an ornamental in Guam. Another, unidentified, seen growing in a pot in Kwajalein in 1956.

Podocarpus gracilior Pilger

Podocarpus gracilior Pilger, Pflanzer. IV, 5:71, 1903.

Leaves alternate, linear-lanceolate, 5–8 cm long, 2–5 mm wide, acuminate; seed globose, 12–20 mm long.

There is some doubt about this identification as the specimens are sterile.

Native of Africa, imported to Guam by Mayo Nursery, sparingly planted as an ornamental.

Marianas Islands.—Guam: Agana (Mayo Nursery), *Souder A-9* (Fo), *34* (Fo).

Another *Podocarpus* introduction reported by Paul Souder (in litt.) in 1967 may or may not be the same. We do not know if it survived.

PINACEAE

Resinous trees and shrubs with linear or needle-like leaves; strobiles monoecious; microsporophylls in small herbaceous strobiles, microsporangia 2–6, fused to lower sides of microsporophylls; megasporophylls in larger woody strobiles, each with two ovules at base of upper side; seeds winged, borne on upper surfaces of woody scale-like megasporophylls.

Mainly North Temperate, a few species in tropical mountains; in Micronesia only a few sporadically cultivated species.

Pinus L.

Pinus L., Gen. Pl. ed. 5, 434, 1754 [1753].

Trees; branches whorled, leaves borne in fascicles in axils of scales, fascicles surrounded at base by a sheath; ovulate strobiles (cones) woody, scales persistent.

Many species in North Temperate regions, a few in tropical mountains; two have been cultivated in Micronesia.

Key to the Micronesian Species of *Pinus*

Needles less than 1 mm wide, twigs without prominent decurrent ridges below the needle clusters ..... ***P. luchuensis***

Needles about 1 mm wide, twigs with ridges below needle clusters ..... ***P. thunbergii***

Pinus luchuensis Mayr

Pinus luchuensis Mayr, Bot. Centralbl. 18:149, 1894.—Stone, Micronesica 6:66, 1971.

Trees with dark gray slender twigs with persistent woody scales; needles 2 in a fascicle, slender, about 0.9 mm or less thick, 6–16 cm long; cones ovoid, 3–6 cm long and wide (when opened up), scales with umbo sharply distinct, scarcely mucronate; body of seed up to 5 mm, with wing to almost 2 cm.

Native to Ryukyu Islands, naturalized in the Bonins; a single tree planted on Nimitz Hill is probably this species, although it was sterile when collected, leaving some doubt as to its identity. Paul Souder (pers. comm., 26 May 1966) says that this tree at that time was producing small cones. He also informed us that two other trees were growing at Yigo, brought from Chichi Jima, Bonin Islands.

Marianas Islands.—Guam: s. l. *Souder 9* (Fo), Nimitz Hill, single planted tree, 170 m, *Fosberg 43493* (US, BISH, Fo) (the Souder collection is from same tree as Fosberg one).

Pinus thunbergii Parlatore

Pinus thunbergii Parlatore in de Candolle, Prodr. 16 (2):388, 1868.—Fosberg and Sachet, Atoll Res. Bull. 92:4, 1962.

Tree, with brown twigs, with ridges or carinae decurrent from bases of leaf fascicles; needles in fascicles of 2, stiff, mostly about 1 mm wide, 6–11 cm long; cones ovoid, umbo with a short mucro.

Native of Japan, once reported as planted in Jaluit, Marshall Islands, but not seen there recently.

Marshall Islands.—Jaluit: Fosberg and Sachet, 1962:4 (citing Okabe, 1941).

TAXODIACEAE

Trees with needle-like, scale-like or subulate, alternate or opposite, distichous or spiraled leaves; strobiles monoecious, the staminate small or somewhat elongate, with 2–9 microsporangia to a scale; ovulate terminal, ovules 2–9 to a megasporophyll, mature cones woody, with persistent woody scales these peltate or flattened, each with 2–9 wingless seeds.

A number of genera scattered over the temperate and subtropical parts of the world, with restricted, relict types of distribution. Included are the redwood, giant sequoia, bald cypress, and the sugi. The latter was once planted in Guam, but has not been collected or seen recently.

Cryptomeria D. Don

Cryptomeria D. Don, Trans. Linn. Soc. 18:166, 1841.

Large trees with massive trunks; leaves spirally arranged, subulate, sulcate, decurrent on stem at base, conspicuously differing in length on successive segments of twigs; strobiles monoecious, staminate spicately arranged in clusters on ends of small branchlets; pistillate terminal on small branchlets, globose, when mature about 12–20 mm across, their scales tipped by one to several scale-like triangular to subulate processes. One species, native to eastern Asia.

Cryptomeria japonica (L. f.) D. Don

Cryptomeria japonica (L.f.) D. Don, Trans. Linn. Soc. 18:166, pl. 13: fig. 1, 1841.—Merrill, Phil. Jour. Sci. Bot. 9:47, 1914.—Bryan, Guam Recorder 13 (12):13, 1937.—Stone, Micronesica 6:67, 1971.
Cupressus japonica L. f., Suppl. 421, 1781.

Characters of the genus.

Native to China and Japan; once collected as a cultivated plant in Guam. An important timber tree in Japan, called "sugi."

Marianas Islands.—Guam: s.l. *G.E.S. 433* (US). Merrill, 1914:47. Bryan, 1937:13. Stone, 1971:67.

CUPRESSACEAE

Trees and shrubs; leaves opposite or whorled, scale-like, subulate, or acicular; strobiles monoecious or dioecious, staminate small, with microsporangia on lower side of margin of somewhat peltate scales, ovulate with few scales, these opposite or whorled, peltate or rarely flattened, rarely fleshy and fused, forming a berry; ovules 1–12 per scale; seeds winged or not.

A few genera, found in most parts of the world, many cultivated; a few species have been introduced in Micronesia but only four known to have survived, these uncommon. Various other horticultural varieties of *Juniperus* and *Thuja* were introduced a few years ago (Paul Souder, in litt.) but their fate is not known to us.

Key to the Micronesian Genera of Cupressaceae

1. Branch systems notably flattened in one plane ..... ***Thuja***
1. Branch systems not so flattened 2
   2. Some leaves usually acicular or subulate, fruiting cone modified into a fleshy berry-like structure ..... ***Juniperus***
   2. Leaves with no tendency to be subulate or acicular, fruiting cones woody, with separate peltate segments ..... ***Cupressus***

Cupressus L.

Cupressus L., Gen. Pl. ed. 5, 435, 1754 [1753].—Stone, Micronesica 6:67–68, 1971.

Trees with thin exfoliating or thicker shreddy bark; leaves all scale-like, opposite, often with a conspicuous dorsal gland; strobiles monoecious, staminate small, microsporophylls decussate, pistillate subglobose, maturing in two years, woody, scales peltate, seeds numerous, winged.

Scattered in warmer parts of northern hemisphere, several species planted as ornamentals and windbreaks; one species very rarely planted in Guam.

Cupressus sempervirens L.

Cupressus sempervirens L., Sp. Pl. 1002, 1753.

Tree; leaves conspicuously glandular, obtuse; cones subglobose 2.5–3.5 cm across. Native of southern Europe and western Asia, one sterile young plant in a garden in Guam may be this.

Marianas Islands.—Guam: Yigo, 120 m, *Fosberg 35403* (US).

Juniperus L.

Juniperus L., Gen. Pl. ed. 5, 461, 1754 [1753].—Stone, Micronesica 6:67–68, 1971.

Trees and shrubs, branch systems not usually flattened, leaves scale-like or subulate, ovulate strobiles with scales in fruit fleshy and connate into a berry; seeds wingless.

Northern hemisphere, many species cultivated as ornamentals; a few have been planted in Guam, of which at least the following have survived.

Key to the Micronesian Species of *Juniperus*

Scale-like leaves acute ..... ***J. virginiana***
Scale-like leaves obtuse ..... ***J. chinensis***

Juniperus chinensis L.

Juniperus chinensis L., Mantissa 1:127, 1767.

Shrub or small tree; juvenile leaves subulate or acicular, pungently pointed, mature leaves scale-like, obtusely pointed. All plants seen sterile, so the identification is doubtful.

Planted as an ornamental, native to China; introduced to Guam after World War II. There are many horticultural varieties, but to attempt to identify them from material available would be useless.

Marianas Islands.—Guam: Agaña, *Souder 43* (Fo). Agaña Heights, 50 m, *Fosberg 43485* (US).

Juniperus virginiana L.

Juniperus virginiana L., Sp. Pl. 1039, 1753.

Small tree, branch tips tending to be recurved; juvenile leaves subulate or acicular, pungently pointed, leaves of mature growth scale-like, acutely pointed. Plant seen sterile, so identification uncertain.

Native to eastern North America; planted in Guam as an ornamental, introduced after World War II.

Marianas Islands.—Guam: Agaña, *Stone* s. n. in 1964, sterile (UG). Tamuning, 30 m, *Evans 1636* (US, BISH, Fo).

Thuja L.

Thuja L., Gen. Pl. ed. 5, 435, 1754 [1753] [as *Thuya*].—Stone, Micronesica 6:67–68, 1971.
Biota D. Don in Lambert, Pinet. ed. 2, 2:129, 1828.

Shrubs or usually trees, evergreen, branchlet systems in one plane, branchlets flattened in same plane; leaves scale-like, opposite, in four ranks, dimorphic; strobiles monoecious, staminate with 6–12 decussate scales, ovulate with 6–12 thick peltate scales; seeds 2–3 to a scale, winged or not.

A few species in eastern Asia and North America, one in cultivation in Micronesia.

Thuja orientalis L.

Thuja orientalis L., Sp. Pl. 1002, 1753.
Biota orientalis (L.), Endlicher, Syn. Conif. 47, 1847.

Branchlet systems in vertical planes; leaves strongly imbricate; cones ovoid, 1.5–2.5 cm long, scales thick, fleshy until completely ripe, bearing a hooked process below apex; seeds 2 to a scale, wingless.

Native of China and Korea, sparingly planted as an ornamental in Guam.

Mariana Islands.—Guam: Agaña, *Souder 41* (Fo). Manguuao, cultivated, *Fosberg 35623* (US), *35636* (US).

GNETACEAE

Trees or lianes, without resin ducts, but with mucilage ducts; branches opposite (sometimes one suppressed), nodes enlarged; leaves broad, opposite; "flowers" dioecious or rarely monoecious, in whorls on pedunculate spikes, each whorl subtended by a cup-shaped bract, staminate flowers with funnel-shaped perianth, 2 stamens, a few sterile pistillate flowers in same inflorescence; pistillate flowers whorled, each of a single ovule with a style-like micropylar tube, surrounded by a fleshy, cup-shaped perianth, some pistillate flowers may be sterile even in pistillate spikes; seeds fleshy, drupe-like, with woody middle integument, endosperm horny.

A single genus. This family is isolated from the other Gymnospermae and, with the Ephedraceae and Welwitchiaceae, may be intermediate between them and the Angiospermae.

Gnetum L.

Gnetum L., Mantissa 1:18, n. 1278, 1767.

Characters of the family. A pantropic genus, one poorly known species from Palau, provisionally referred to the widespread *G. gnemon* L.

Gnetum gnemon L.

Gnetum gnemon L., Mantissa 1:125, 1767.

Trees, leaves elliptic to ovate, shortly acuminate and shortly petiolate, chartaceous, 8–10 cm or more long; spikes axillary or terminal on lateral branchlets, simple or somewhat paniculate, 3–8 cm long; seed subcylindric to ellipsoid, substipitate, mucronate, 1.5–2 cm long, about 1 cm wide.

Only sterile material seen from Micronesia, description of spikes and seeds from material from other areas.

The leaves of the material seen from Palau have the texture of many examples of *G. gnemon* from other areas, but the venation is much nearer that of *G. indicum,* in that the lateral veins are much more strongly arching and approach closer to the margin. When better material of the Micronesian plant is available, it may be found to be a new species or an extension of range for either *G. indicum* (Loureiro) Merrill or *G. neglectum* Blume, but it does not seem advisable to make any other disposition than to place it in the widespread *G. gnemon* for the present.

Gnetum gnemon is an important food plant in Indonesia, the seeds being crushed and roasted or baked and eaten.

Caroline Islands.—Palau Islands: Aulupse'el (Aurapushekaru): Northwest end, just south of Koror, *Stone & Sabina 4541* (BISH) ("fls green"). Alumezu: *Hosokawa 9061* (BISH).

Literature Cited

Bryan, E. H., Jr.

[1946]. The Plants of Guam. Sets of unnumbered page proofs, Arnold Arboretum Library, Cambridge, Mass.; Bernice P. Bishop Museum, Honolulu; and files of F. R. Fosberg, Department of Botany, National Museum of Natural History, Smithsonian Institution. [A revised version of the first 26 parts of a work of this title printed as a series of short articles in the *Guam Recorder,* beginning in 1937 and interrupted by World War II.]

Dumont d'Urville, J. [S. C.]

1832. Notices sur les îles du Grand Océan. *Bulletin de la Société de Géographie* (Paris), 17:1–21.

Fosberg, F. R.

1960. The Vegetation of Micronesia, 1. *Bulletin of the American Museum of Natural History,* 119:1–75.

Gaudichaud, C.

1826. Botanique. In *Voyage autour du monde entrepris par ordre du roi. . . exécuté sur les corvettes de* S. M. l'Uranie *et* la Physicienne *pendant les années 1817, 1818, 1819, 1820, . . . par M. Louis de Freycinet.* 522 pages. Paris. [Actual dates of publication 1826–1830.]

Glassman, S. F.

1952. The Flora of Ponape. *Bernice P. Bishop Museum Bulletin,* 209:1–152.

Gressitt, J. L.

1954. Insects of Micronesia—Introduction. Volume 1 *in* Gressitt, editor, *Insects of Micronesia.* 257 pages. Honolulu: Bernice P. Bishop Museum.

Hosokawa, T.

n.d. [Enumeration of the Flora of Micronesia.] Manuscript in Japanese and English, files of F. R. Fosberg, Department of Botany, National Museum of Natural History, Smithsonian Institution.

Kanehira, R.

1933. *Flora Micronesica.* 468 pages. Tokyo.

1935. An Enumeration of Micronesian Plants. *Journal of the Department of Agriculture* (Kyushu University), 4:237–464.

Lanjouw, J., and F. A. Stafleu

1964. Index Herbariorum, Part I: The Herbaria of the World. 5th edition. *Regnum Vegetabile,* 31:1–251.

Merrill, E. D.

1914. An Enumeration of the Plants of Guam. *Philippine Journal of Science* (Section C. Botany), 9:17–155.

1919. Additions to the Flora of Guam. *Philippine Journal of Science,* 15:539–544.

Otobed, D. O.

1967. Guide List of the Plants of the Palau Islands. Duplicated by the Biology Laboratory, Koror, Palau, Caroline Islands. [Revised in 1971.]

Sachet, M.-H., and F. R. Fosberg

1955. *Island Bibliographies.* v + 577 pages. Washington: National Academy of Sciences. [National Research Council pub. 335.]

1971. *Island Bibliographies Supplement.* ix + 427 pages. Washington: National Academy of Sciences.

Safford, W. E.

1905. The Useful Plants of the Island of Guam. *Contributions from the United States National Herbarium,* 9:1–416.

Stone, B. C.

1971. The Flora of Guam. *Micronesica,* 6:1–659.

Taylor, W. R.

1950. *Plants of Bikini and Other Northern Marshall Islands.* 227 pages. Ann Arbor: University of Michigan Press.

Index

☆ U.S. GOVERNMENT PRINTING OFFICE 1975—— 546–365/4

Publication in *Smithsonian Contributions to Botany*

Manuscripts for serial publications are accepted by the Smithsonian Institution Press, subject to substantive review, only through departments of the various Smithsonian museums. Non-Smithsonian authors should address inquiries to the appropriate department. If submission is invited, the following format requirements of the Press will govern the preparation of copy.

Copy must be typewritten, double-spaced, on one side of standard white bond paper, with 1½″ top and left margins, submitted in ribbon copy with a carbon or duplicate, and accompanied by the original artwork. Duplicate copies of all material, including illustrations, should be retained by the author. There may be several paragraphs to a page, but each page should begin with a new paragraph. Number consecutively all pages, including title page, abstract, text, literature cited, legends, and tables. The minimum length is 30 pages, including typescript and illustrations.

The *title* should be complete and clear for easy indexing by abstracting services. Taxonomic titles will carry a final line indicating the higher categories to which the taxon is referable: "(Leguminosae: Faboideae)." Include an *abstract* as an introductory part of the text. Identify the *author* on the first page of text with an unnumbered footnote that includes his professional mailing address. A *table of contents* is optional. An *index,* if required, may be supplied by the author when he returns page proof.

Two *headings* are used: (1) text heads (boldface in print) for major sections and chapters and (2) paragraph sideheads (caps and small caps in print) for subdivisions. Further headings may be worked out with the editor.

In *taxonomic keys,* for easy reference, number the taxa and their corresponding headings throughout the text; do not incorporate page references in the key.

In *synonymy,* use the long form (taxon, abbreviated author, abbreviated journal or book title, volume, part if necessary, page, year) with no reference at the end of the paper under "Literature Cited" or use the short form (taxon, author, date: page) with a full reference at the end of the paper under "Literature Cited." Begin each taxon at the left margin with subsequent lines indented about three spaces. Within an entry, use a period-dash (.—) to separate each supplementary reference. Enclose with square brackets any annotation in, or at the end of, the entry. For *references within the text,* use the author-date system: "(Jones, 1910)" and "Jones (1910)." If the reference is expanded, abbreviate the data: "Jones (1910: 122, pl. 20: fig. 1)."

Simple *tabulations* in the text (e.g., columns of data) may carry headings or not, but they should not contain rules. Formal *tables* must be submitted as pages separate from the text, and each table, no matter how large, should be pasted up as a single sheet of copy.

Use the *metric system* instead of, or in addition to, the English system.

Illustrations (line drawings, maps, photographs, shaded drawings) can be intermixed throughout the printed text. They will be termed *Figures* and should be numbered consecutively; however, if a group of figures is treated as a single figure, the components should be indicated by lowercase italic letters on the illustration, in the legend, and in text references: "Figure 9*b*." If illustrations (usually tone photographs) are printed separately from the text as full pages on a different stock of paper, they will be termed *Plates,* and individual components should be lettered (Plate 9*b*) but may be numbered (Plate 9: figure 2). Never combine the numbering system of text illustrations with that of plate illustrations. Submit all legends on pages separate from the text and not attached to the artwork. An instruction booklet for the preparation of illustrations is available from the Press on request.

In the *bibliography* (usually called "Literature Cited"), spell out book, journal, and article titles, using initial caps with all words except minor terms such as "and, of, the." For capitalization of titles in foreign languages, follow the national practice of each language. Underscore (for italics) book and journal titles. Use the colon-parentheses system for volume, number, and page citations: "10(2):5-9." Spell out such words as "figures," "plates," "pages."

For *free copies* of his own paper, a Smithsonian author should indicate his requirements on "Form 36" (submitted to the Press with the manuscript). A non-Smithsonian author will receive 50 free copies; order forms for quantities above this amount with instructions for payment will be supplied when page proof is forwarded.


SMITHSONIAN INSTITUTION LIBRARIES

SMITHSONIAN INSTITUTION LIBRARIES

SMITHSONIAN INSTITUTION LIBRARIES
3 9088 01698 5053